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TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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WIND TUNNEL TESTS ON AN AIRFOIL EQUIPPED WITH

A SPLIT FLAP AND A SLOT

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Summary

The investigation described in this report is concerned with the changes in the aerodynamic characteristics of an airfoil which are produced by a gauze-covered suction slot, located near the leading edge, and connected by an air passage to a split flap at the trailing edge. The tests were conducted at the Langley Memorial Aeronautical Laboratory.

At the larger values of lift coefficient where the action of the slot might be expected to be most effective, the pressure differences were such that the air flowed out of the slot rather than in through it, and in consequence, the maximum lift coefficient was decreased.

Introduction

It is known that the lift of airfoils may be increased if the air of the boundary layer is removed by suction acting from the inside of the airfoil, and also, that a suction exists between the parts of a split flap located at the trailing edge.

The following tests were made to determine the aerodynamic

characteristics of an airfoil equipped with a suction slot and a split flap near the trailing edge which were connected by an air passage through the interior of the airfoil. The tests were conducted in the Five-Foot Atmospheric Wind Tunnel of the Langley Memorial Aeronautical Laboratory.

The tests described in Reference 1 indicated that a wide gauze-covered slot located near the leading edge would give the best results with small pressure differences, although this type of slot, with no air flow through it, appears to give considerable spoiler action.

T e s t s

The tests were conducted in the Five-Foot Atmospheric Wind Tunnel on a 15-inch chord, 25-1/4-inch span airfoil which was mounted vertically in the tunnel between large horizontal planes at each end. Figure 1 shows the airfoil mounted in the tunnel between the planes. The airfoil mounting consisted of a vertical spindle passing through and rigidly fastened to the model and the two end disks. The lower end of the spindle was pivoted and to the upper end were attached the force measuring balances by means of wire linkages. Air was prevented from passing between the disks and the planes by means of two liquid seals.

The N.A.C.A. 84-M profile was used and the ordinates are given in Table I. The airfoil was equipped with a split flap and a 3/4-inch slot covered with a fine mesh porous cloth. The

inside of the airfoil was so constructed that the air had free passage from the slot to the opening between the parts of the split flap. In Figures 2 and 3, the airfoil is shown with the flap, slot, and interior air passages.

The lift, drag, and pressure on the inside of the airfoil were measured at various flap settings with and without the slot. For the tests without the slot a solid leading edge piece was used. The planes between which the airfoil was tested restrained the air flow to two dimensions, so that the effect of infinite aspect ratio was approximated.

The dynamic pressure was held constant at 4.06 lb. per sq. ft. during the tests. This corresponds to a speed of about 40 m.p.h. and a Reynolds Number of about 455,000.

Results

The results are presented in Figures 4 to 7, in which the absolute lift and drag coefficients and the pressure P_W inside of the airfoil are plotted versus angle of attack for the various slot and flap combinations. These results are to be considered of comparative value only, due to the limitations of the apparatus at the time these tests were made.

The pressure P_W is given in terms of the dynamic pressure and is measured with reference to the static pressure in the test section of the tunnel. This pressure was measured with and without the slot for each flap setting. The pressure difference

without the slot was that produced between the open parts of the flap by the air flow past them. By a comparison of the pressure differences with and without the slot the direction of air flow through the slot can be determined, as indicated on the curves p_W versus angle of attack (Figs. 5 to 7).

D i s c u s s i o n

Figures 5 to 7 show, as might be expected, that as long as the air flow was in through the slot, the lift was increased with practically no change in drag, but that when the flow was reversed, there was a considerable decrease in lift and increase in drag. As this reversal of flow took place at about 2/3 of the maximum lift coefficient of the airfoil without the slot, the maximum lift coefficient with the slot was considerably decreased. At the high angles of attack, after the complete burble of the airfoil, the lift coefficient was slightly increased, although the pressures indicated that the air was flowing out through the slot. The results of previous tests (Reference 1) indicate that only small increases in lift may be expected at these angles of attack, even with the higher pressures or suctions used in those tests.

The tests were made with the slot in but one location along the chord and there remains the possibility that a better effect might have been obtained with some other slot location. However, the maximum suction developed by the flap is of the order of 1 q and previous tests (Reference 1) with suction slots indicate that

but small, if any, increases in maximum lift may be expected with suctions of this magnitude.

Conclusions

In these tests the maximum lift coefficient of the airfoil was reduced when the gauze-covered slot was added because the split flap did not furnish the pressure difference required for the operation of the slot at the angles of attack of the larger lift coefficients.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., August 14, 1929.

Reference

1. Reid, E. G. and Bamber, M. J. : Preliminary Investigation on Boundary Layer by Means of Suction and Pressure with the U.S.A. 27 Airfoil. N.A.C.A. Technical Note No. 286, 1928.

TABLE I.

N.A.C.A. 84-M Profile Ordinates

Station in per cent of chord	Ordinates upper surface per cent of chord	Ordinates lower surface per cent of chord
0.000	2.920	2.920
1.000	4.947	1.366
2.000	5.920	0.858
4.000	7.390	0.333
6.000	8.445	0.087
8.000	9.320	0.000
10.000	10.090	0.000
12.000	10.750	0.000
16.000	11.930	0.000
20.000	12.855	0.000
25.000	13.680	0.000
30.000	14.160	0.000
40.000	14.475	0.000
50.000	13.910	0.000
60.000	12.425	0.000
70.000	10.250	0.000
80.000	7.580	0.000
90.000	4.285	0.000
95.000	2.606	0.000
99.000	0.993	0.000
100.000	0.253	0.253

Fig.1 Airfoil with split flap and slot mounted between planes in wind tunnel.

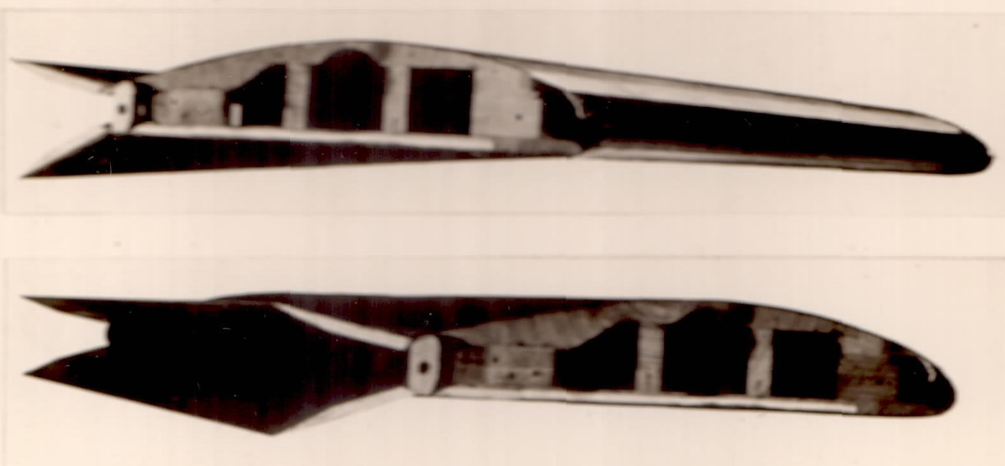

Fig.2 Airfoil showing split flap and gauze-covered slot.

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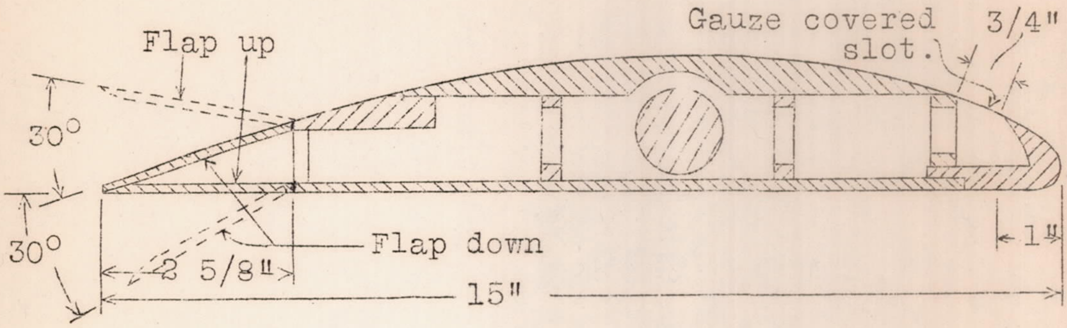

Fig.3 N.A.C.A. 84 Airfoil with split flap-slot combination.

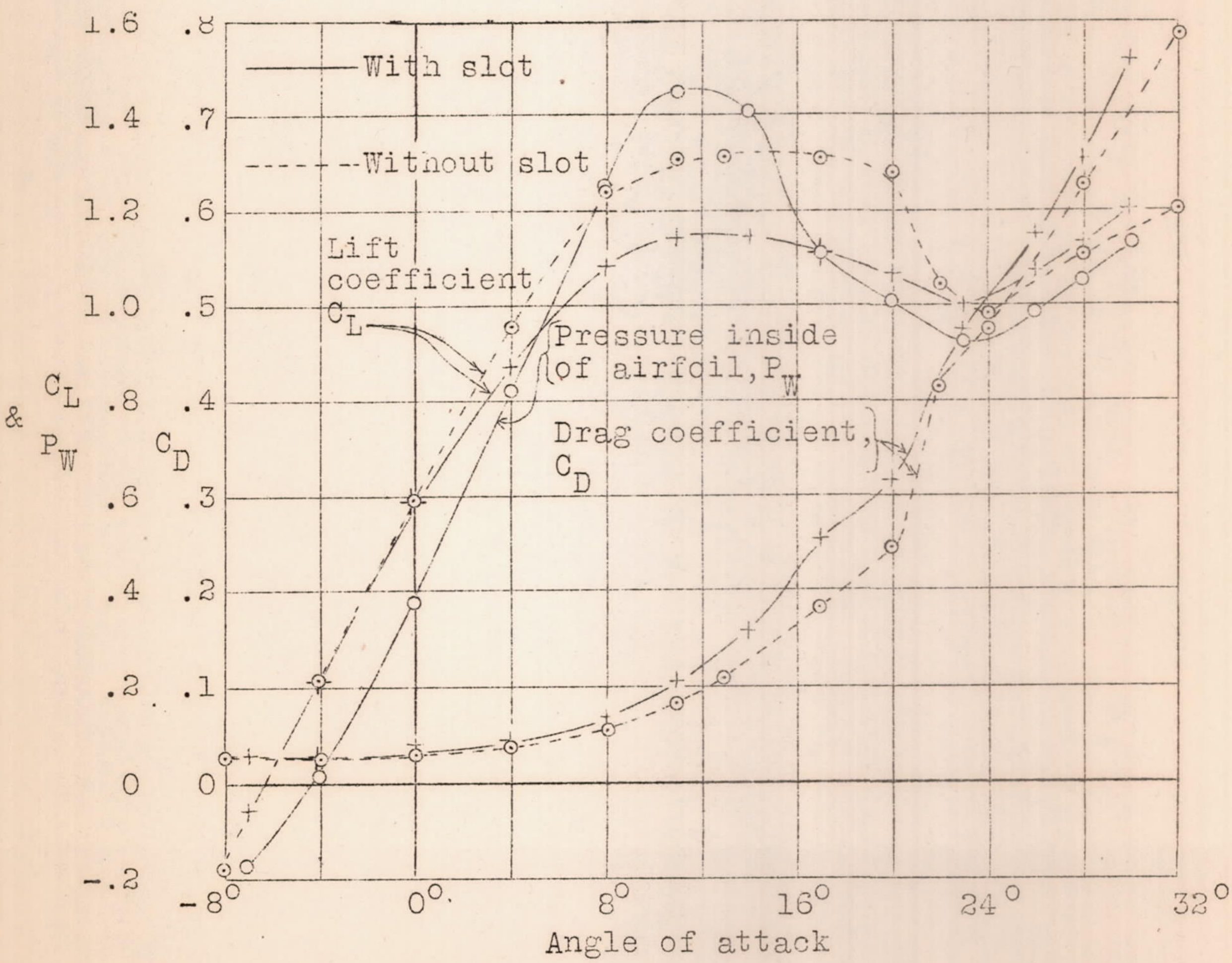

Fig.4 Split flap closed.

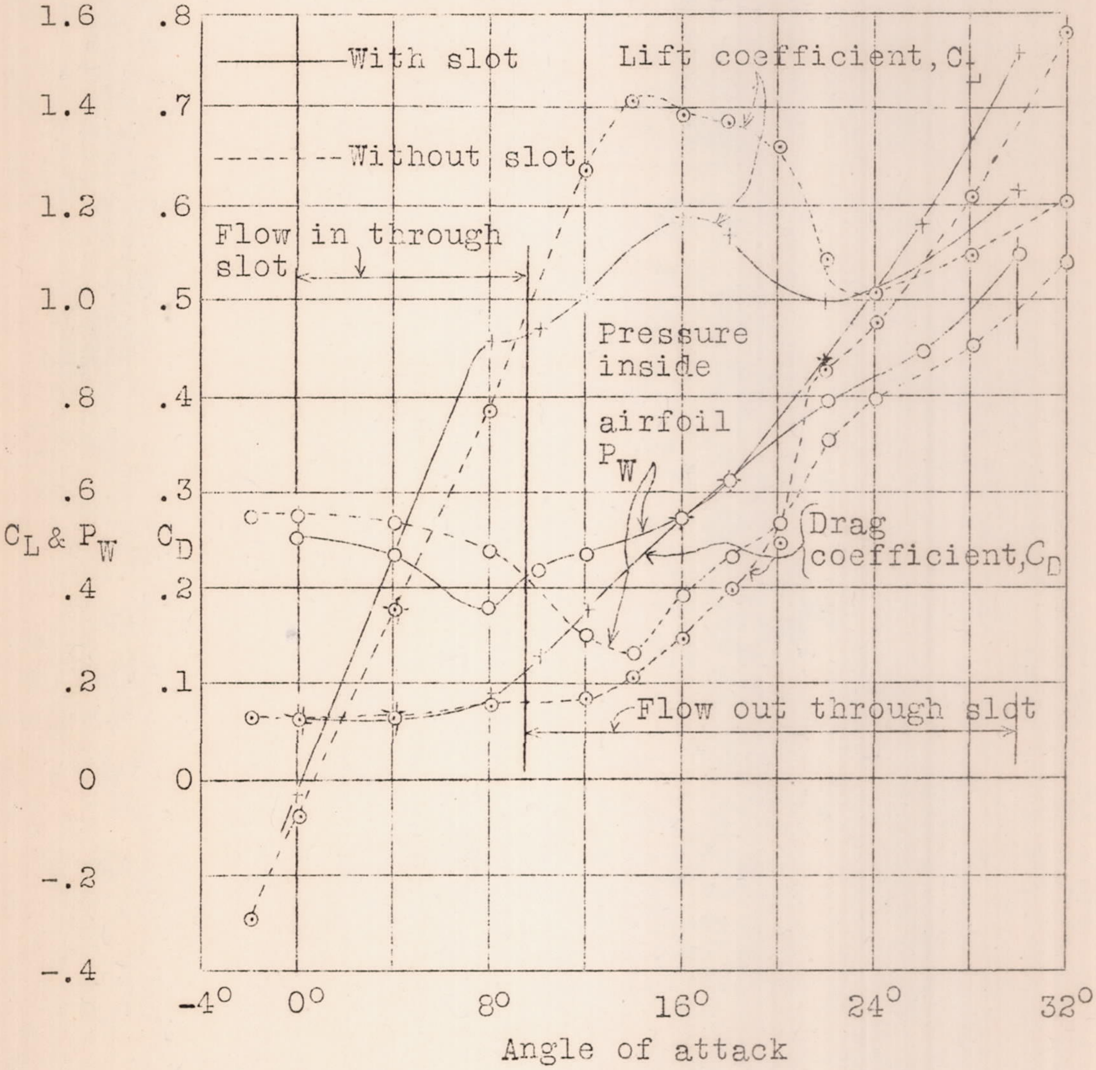

Fig.5 Split flap up 30°.

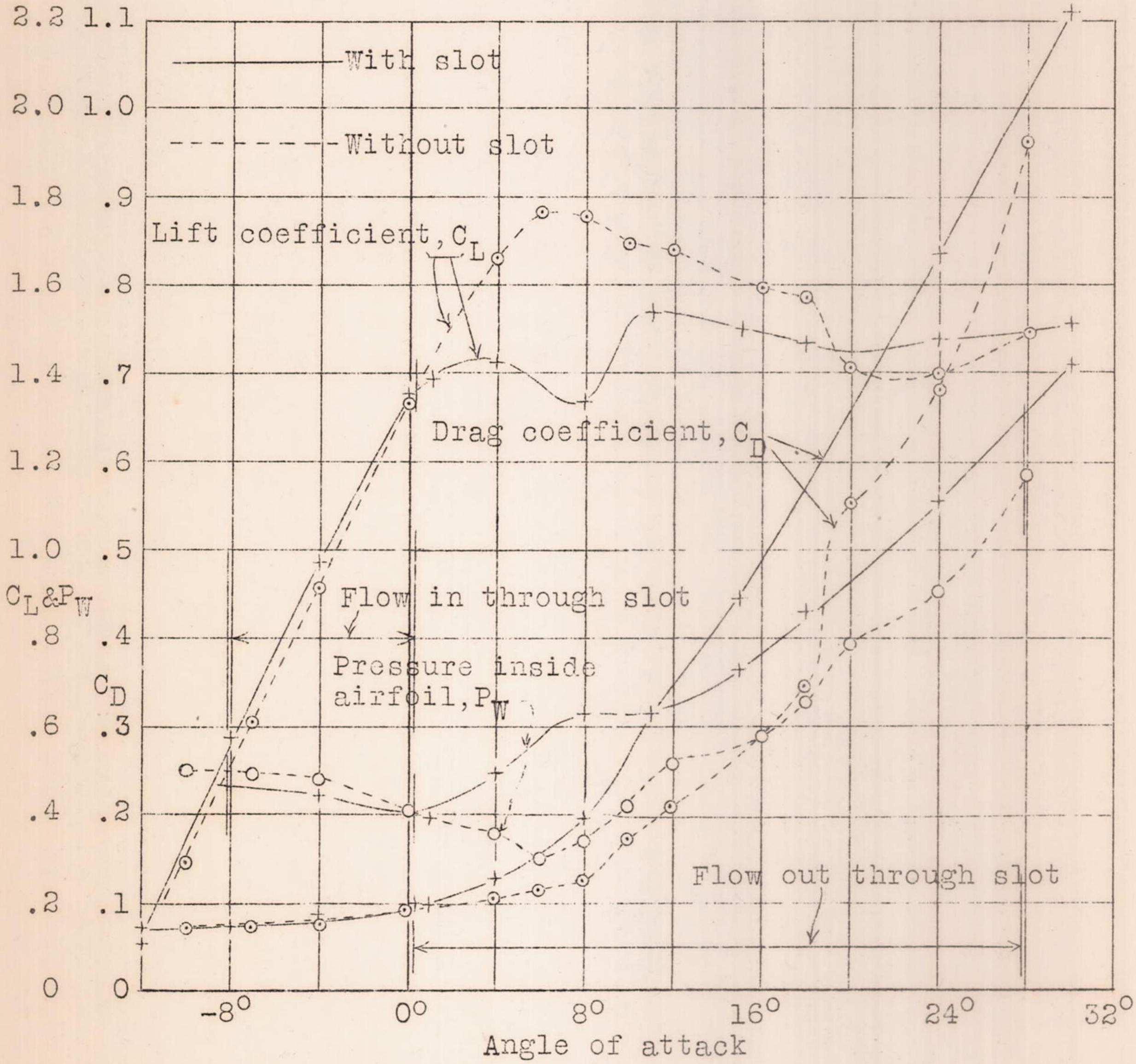

Fig.6 Split flap down 30°.

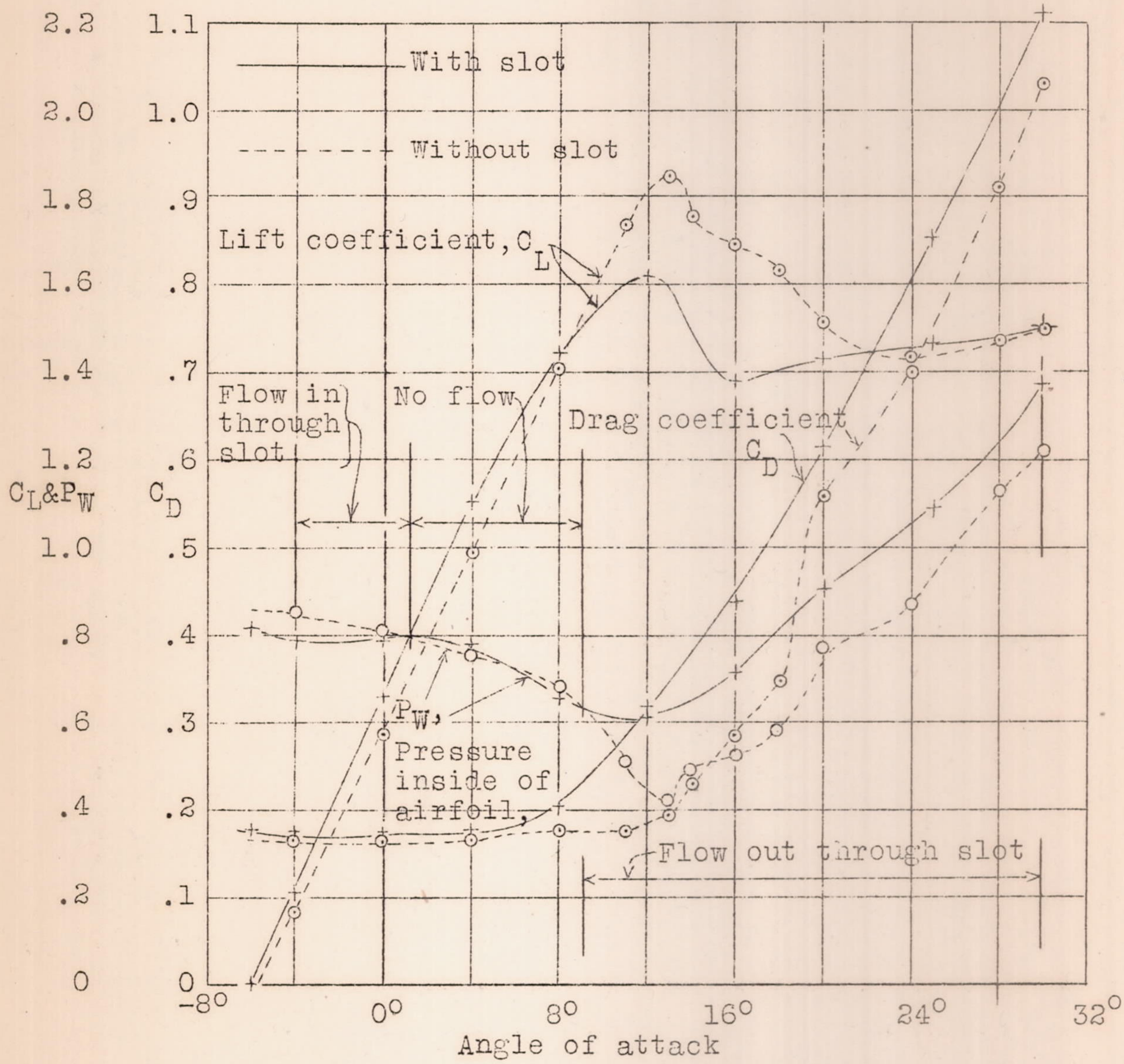

Fig.7 Split flap both parts open 30°.